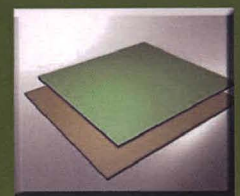


# ADVANCES IN COMPOSITE MATERIALS

---



Iskandar Idris Yaacob  
Md Abdul Maleque  
Zahurin Halim



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# **ADVANCES IN COMPOSITE MATERIALS**

**Iskandar Idris Yaacob  
Md Abdul Maleque  
Zahurin Halim**



**IIUM Press**

Published by:  
IUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IUM Press, IUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Iskandar Idris Yaacob, Md Abdul Maleque & Zahurin Halim: *Advances in Composite Materials*.

ISBN: 978-967-418-231-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by :  
**IUM PRINTING SDN. BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan

# Table of Content

<b>Chapter 1</b>	1
A Critical Review of Metal Matrix Composite Brake Rotor	
	<i>Md Abdul Maleque</i>
<b>Chapter 2</b>	7
Technology of Moulding for Composite Auto Brake Rotor	
	<i>Md Abdul Maleque</i>
<b>Chapter 3</b>	13
Fabrication of Nickel Aluminide (Ni <sub>3</sub> Al) by Hot Isostatic Pressing (HIP)	
	Faizal Abu Zarim, Iraj Alaei, I.I. Yaacob
<b>Chapter 4</b>	17
Investigation of Mechanically Alloyed Nd-Fe-B Powder	
	I.I. Yaacob and H.K. Jun
<b>Chapter 5</b>	23
Synthesis And Characterization Of Nanocrystalline Ni <sub>3</sub> Al Intermetallic Produced by Mechanical Alloying And Reaction Synthesis	
	<i>R. Ismail and I.I. Yaacob<sup>b</sup></i>
<b>Chapter 6</b>	29
The Effect of Hard Nanofillers on Mechanical Properties of PVC Nanocomposites	
	<i>Noorasikin Samat, Muhammad Alif Mohd Yusoff and Mohd Shahrul Rizal Bin Zakaria</i>
<b>Chapter 7</b>	34
Fatigue Fracture Mechanism of PVC/CaCO <sub>3</sub> nanocomposite	
	<i>Noorasikin Samat, Alan Whittle and Mark Hoffman</i>
<b>Chapter 8</b>	40
Mechanical Behaviour of Eco Core Composite Sandwich Structure	
	<i>Norhasnidawani Johari Safiyah Hazwani Abd. Rahim and Zahurin Halim</i>
<b>Chapter 9</b>	45
Characteristics of Oil Palm Biomass via Mixture of Empty Fruit Bunch (EFB) Fiber and Mesocarp Fiber	
	<i>Zahurin Halim, Nabiha Mohd Noh and Nurshazana Mohamad</i>
<b>Chapter 10</b>	49
Mechanical Behaviour of Oil Palm Empty Fruit Bunch (OPEFB) Alumen-Composites Concrete	

*Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad*

<b>Chapter 11</b>	55
The Influence of Biopolymer and Natural Fiber on the Physical and Mechanical Properties of Cement Composite	
<i>Norshahida Sarifuddin and Zuraida Ahmad</i>	
<b>Chapter 12</b>	62
Thermal and Morphological Study of Biopolymer Cotton-Albumen Clay (BCAC) Composites	
<i>Zuraida Ahmad, Teoh Swin Le and Kumaran A/L Samannamuthaliar</i>	
<b>Chapter 13</b>	68
Effect of Compaction Time on the Properties of Coir Fiber Reinforced Cement-Albumen Composite	
<i>Amir Zakwan Roslin, Nur Humairah A. Razak and Zuraida Ahmad</i>	
<b>Chapter 14</b>	74
Oil Palm Empty Fruit Bunch (OPEFB) for Lightweight Composites Concrete	
<i>Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad</i>	
<b>Chapter 15</b>	80
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 1)	
<i>Md Abdul Maleque</i>	
<b>Chapter 16</b>	86
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 2)	
<i>Md Abdul Maleque</i>	
<b>Chapter 17</b>	90
Wear of Aluminium Matrix Composite – Effects of Reinforcement Combination	
<i>Md Abdul Maleque and Rezaul Karim</i>	
<b>Chapter 18</b>	96
Mechanical Properties of Wood Plastic Composites	
<i>Ooi Chong Jin and Shahjahan Mridha</i>	
<b>Chapter 19</b>	101
Properties of Wood Fiber Reinforced Polypropylene Composite	
<i>Shahjahan Mridha and Nafis Sarwar Islam</i>	

<b>Chapter 20</b>		108
The effects of chemical and mechanical treatments on coir fibre to mechanical properties of coir-albumen-concrete		
	<i>Zuraida Ahmad and Nurizan Omar</i>	
<b>Chapter 21</b>		114
Architecture of Chopped Fiber Glass in Plastic Composite Processed Under Different Loads		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
<b>Chapter 22</b>		119
Variation of Fiber Architecture on Loads applied in Fabrication of Epoxy/Woven Fiber Glass Composite		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
<b>Chapter 23</b>		125
Impact Behavior of Carbon/ Epoxy Composite in Moisture and Temperature environments		
	<i>Shahjahan Mridha</i>	
<b>Chapter 24</b>		132
Impact Strength Behaviour of the Woven and Chopped Fiber Glass Composites at Different Temperatures		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
<b>Chapter 25</b>		138
An Investigation of Hybrid Composites Tubes Subjected to Quasi-Static Loading		
	<i>Farrah Yussof<sup>1</sup> and Zuraida Ahmad</i>	
<b>Chapter 26</b>		144
Mechanical Behaviour of Biopolymer Cotton Albumen Clay (BCAC) Composites		
	<i>Teoh Swin Le, Kumaran A/L Samannamuthaliar and Zuraida Ahmad</i>	
<b>Chapter 27</b>		150
The Effect of Processing Parameters on Tensile Properties Empty Fruit Bunch (EFB) Fiber Reinforced Thermoplastic Natural Rubber Composites		
	<i>Noor Azlina Hassan, Norita Hassan, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
<b>Chapter 28</b>		155
Manganese Doped Hydroxyapatite Powder through Hydrothermal Method		
	<i>Asep Sofwan Faturohman, Alqap, Iis Sopyan and Niur Izzati Mazmaa</i>	

<b>Chapter 29</b>	161
Synthesis and Characterization of Sol-Gel Method Derived Zinc Doped Hydroxyapatite Powder	
<i>Asep Sofwan Faturohman Alqap, Nor Hidayu and Iis Sopyan</i>	
<b>Chapter 30</b>	167
Synthesis and Characterization of Nickel Iron–Silicon Nitride Nanocomposite	
<i>Iskandar I. Yaacob</i>	
<b>Chapter 31</b>	172
Fabrication of Nickel Aluminide Intermetallic-Alumina Nanocomposite	
<i>Roslina Ismail and Iskandar I. Yaacob</i>	
<b>Chapter 32</b>	178
Investigation on the Effect of Water Immersion on Cotton Albumen Composite	
<i>Zahurin Halim, Zuraida Ahmad and Fauziah Md Yusof</i>	
<b>Chapter 33</b>	182
Numerical and Experimental Investigation of Peel Strength of Composite Sandwich Structures	
<i>Zahurin Halim , Shahnor Basri and Mohd Ramli Ajir</i>	
<b>Chapter 34</b>	190
Finite Element Analysis of Interlaminar Stresses in Edge Delamination	
<i>Zahurin Halim and Meor Mohd. Adli Taib</i>	

# Fabrication of Metal Matrix Composite Automotive Brake Rotor: Part 1

Md Abdul Maleque<sup>1</sup>

<sup>1</sup>Faculty of Engineering – International Islamic University Malaysia

✉ : maleque@iiium.edu.my

---

**Keywords:** Metal matrix composite, brake rotor, fabrication methods, stir casting, microstructure.

**Abstract:** Fabrication process selection plays a big role in the development process. The fabrication processes those are suitable for automotive brake rotor production have been identified and presented in this paper. A detail fabrication method steps for the fabrication of SiC reinforced aluminium matrix composite (Al-MMC) brake rotor using stir casting process has been explained. Several factors such as stirrer blade (impeller blade) length and angle, stirring the semi-liquid metal, stirring time are considered during fabrication process. It is found that the fabrication method (which is stir casting) among other fabrication methods, is better choice than others due to its simplicity, lower processing temperature, leading to longer die life and high production cycle time, flexibility and applicability to large quantity production. The microstructure of Al-MMC from the stir casting showed homogeneous cast composition whereby almost uniform distribution of SiC particles in the matrix.

## Introduction

Metal matrix composites are fabricated in solid, liquid or gaseous state processes. Selection of matrix materials for a composite structure requires a great consideration. Factors involve in composite manufacturing are: suitable matrix materials, reinforcement types (the form in which the reinforcement is to be used), and heat treatment. Ceramic particulate is the 'reinforcement of choice', since it provides higher wear resistance, strength and stiffness. These composite materials offer outstanding properties such as high strength-to-weight ratio, stronger and stiffer, highly wear and corrosion resistant, outstanding durability and low cost processing route. The AMCs are increasingly being used in high-tech structural and functional applications including automotive, aerospace, defense and thermal management areas, as well as in sports and recreation [1].

The understanding of the capabilities and limitations of manufacturing processes are important to create cost-effective designs, regardless of the materials to be used. In order to design composite structure, it is essential that the processes be understood. Selection of processes depends on:

- the type and form of material
- the shape of the parts to be made
- the quantity to be produced
- the quality, e.g., tolerances required